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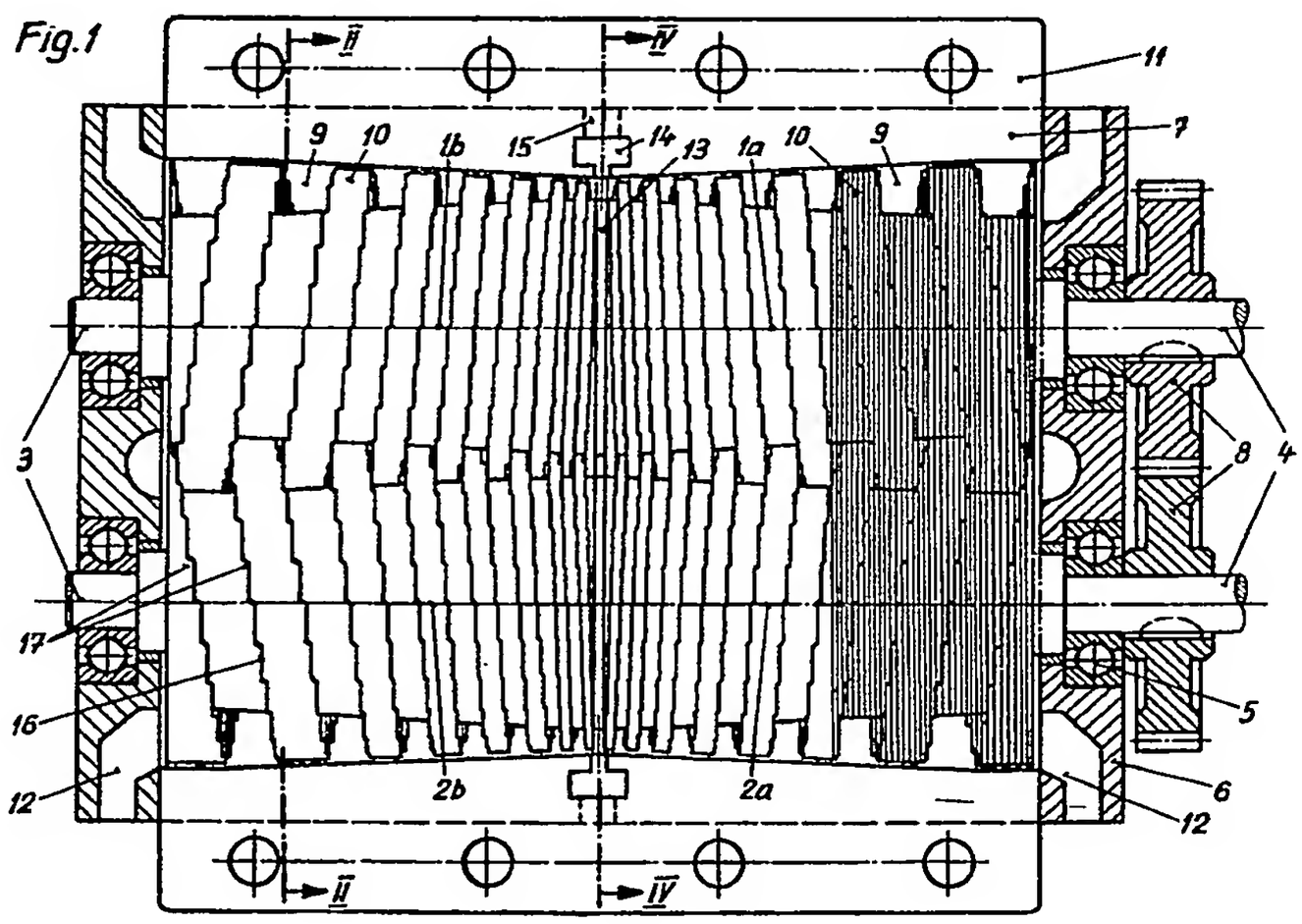
(54) Rotary-piston fluid-machines

(57) A meshing-screw compressor, or expander, comprises twin screw-rotors, or "spindles", (1*a*,*b*; 2*a*,*b*), each rotor having a helical slot (9) in each half thereof whose cross-section decreases toward the rotor center. The sides of the slot (9) are constituted by stepped flats (16) standing perpendicular to the rotor axes. Each rotor may thus be formed by a stack of laminae, or "disks", on a shaft 4 (as indicated in the right-hand half of Fig. 1). Channels 12, 14 for low and high pressure working-fluid may be disposed in the casing 7 as shown.

Fig.1



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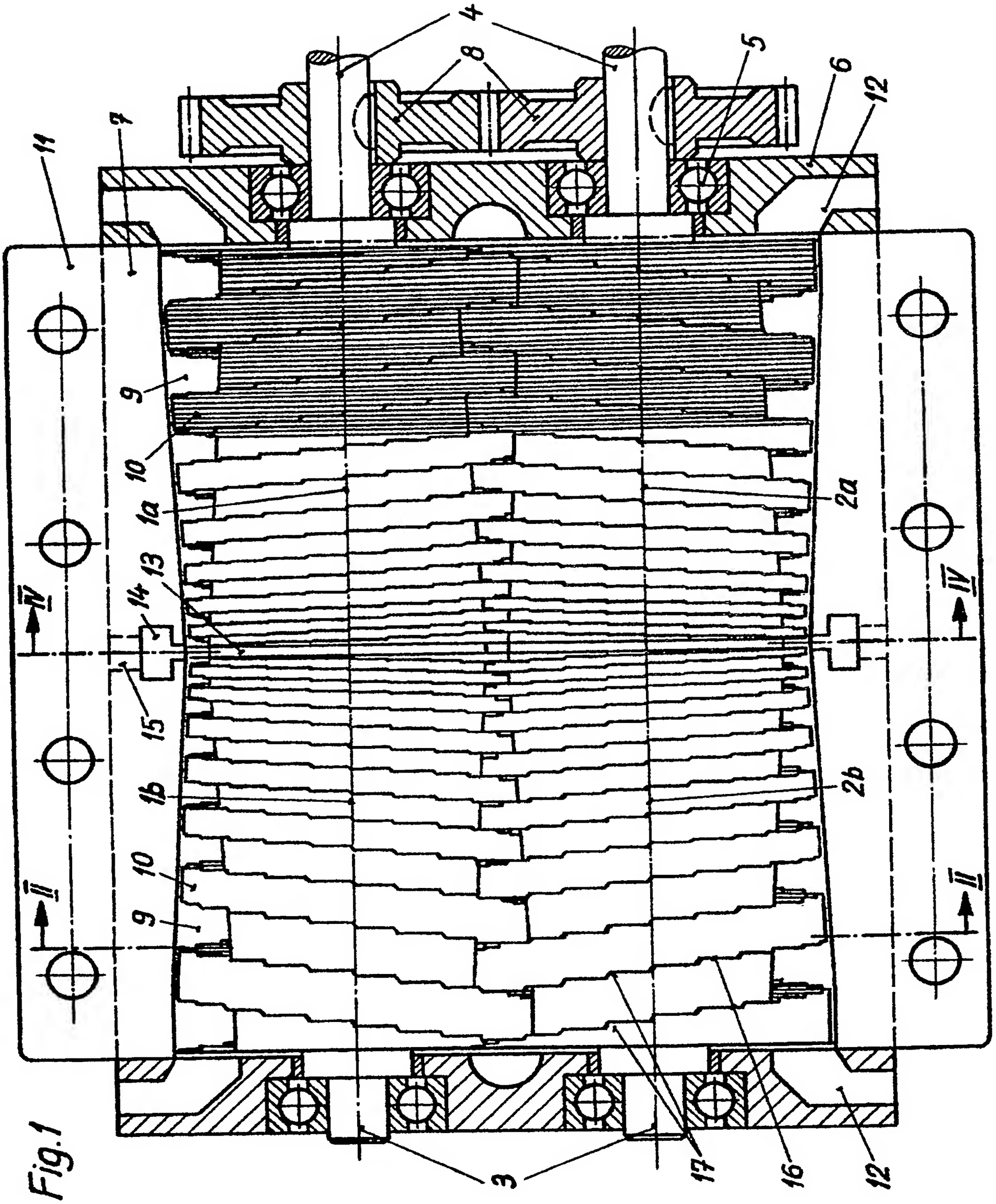
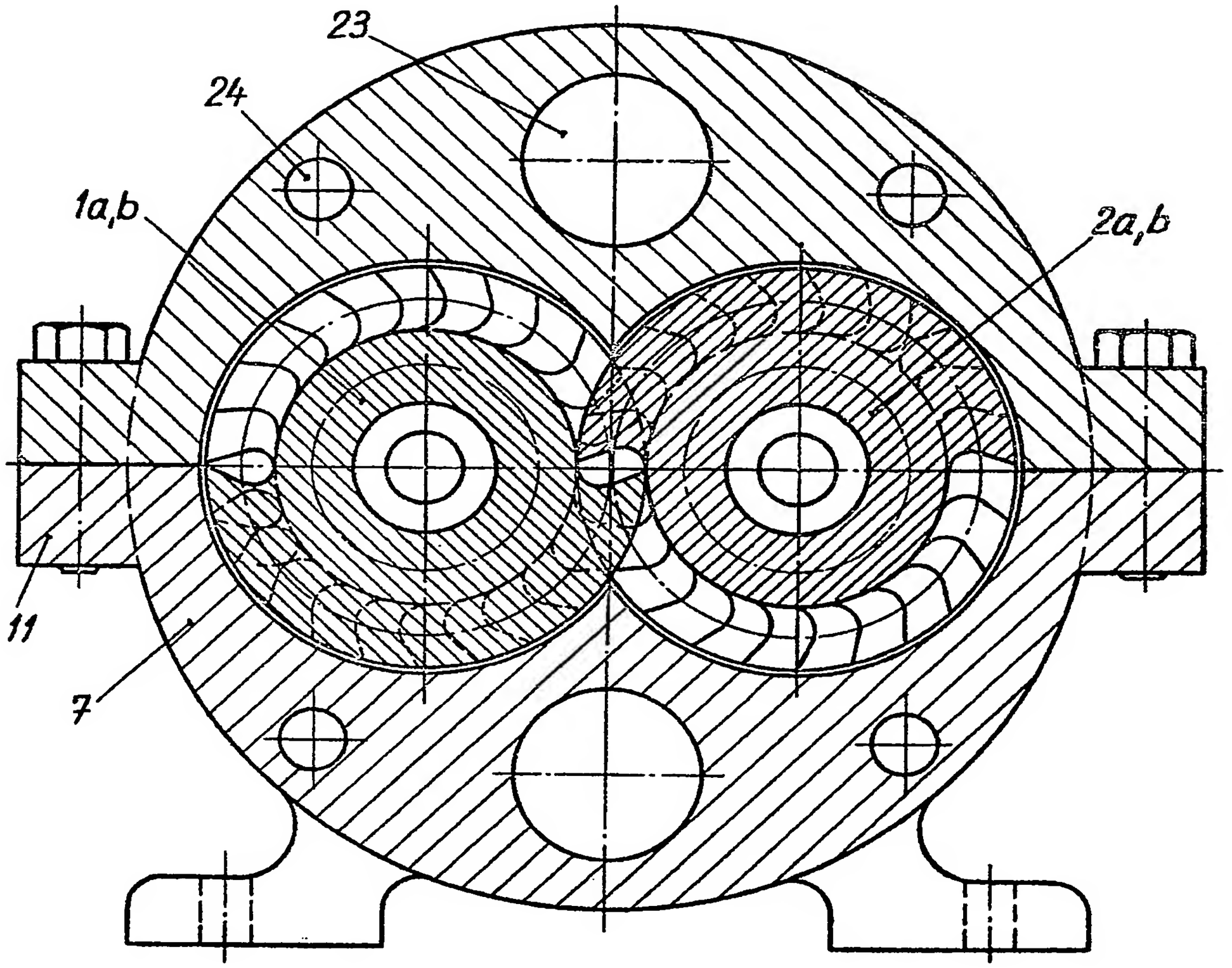


Fig.1

Fig.2



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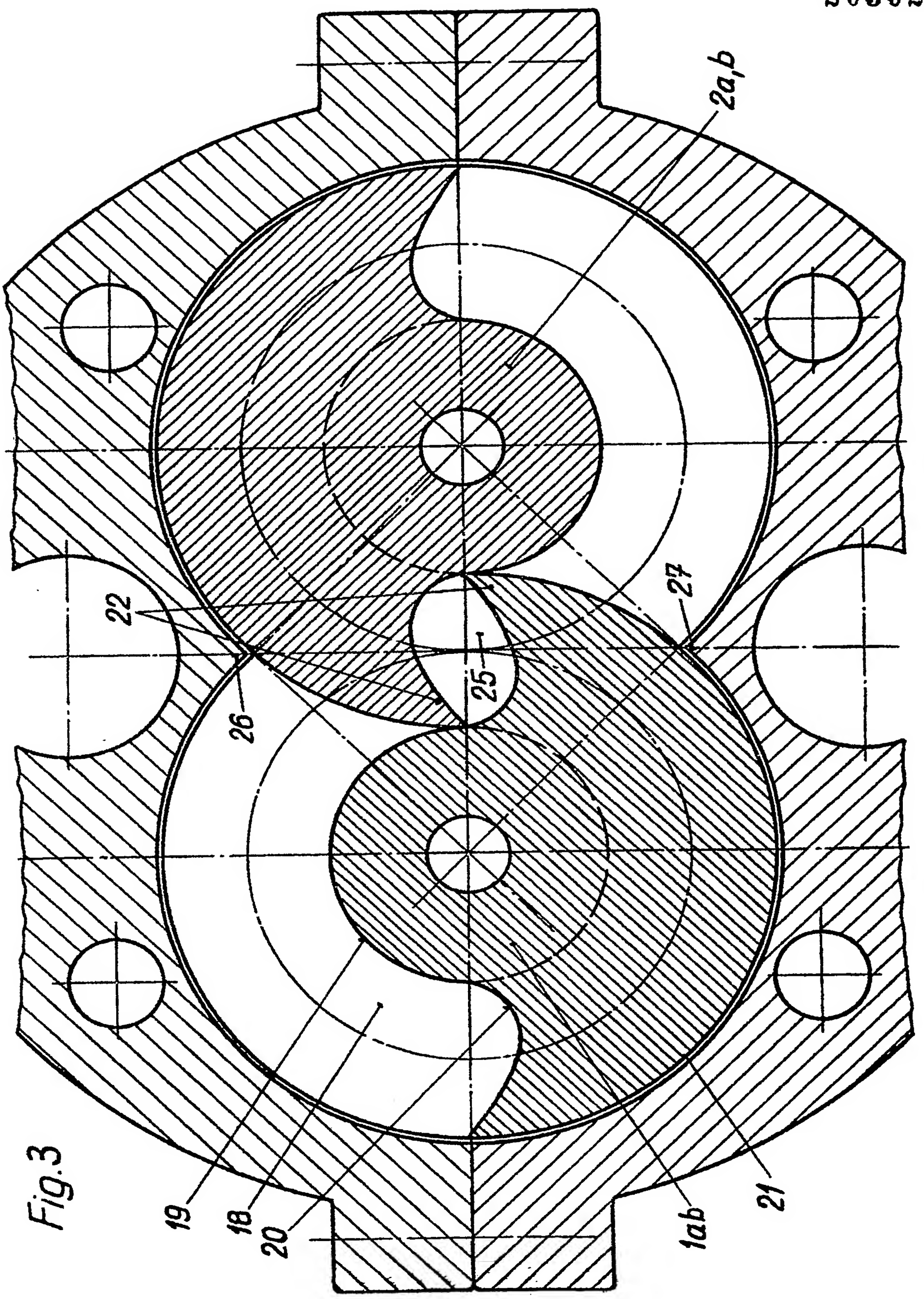
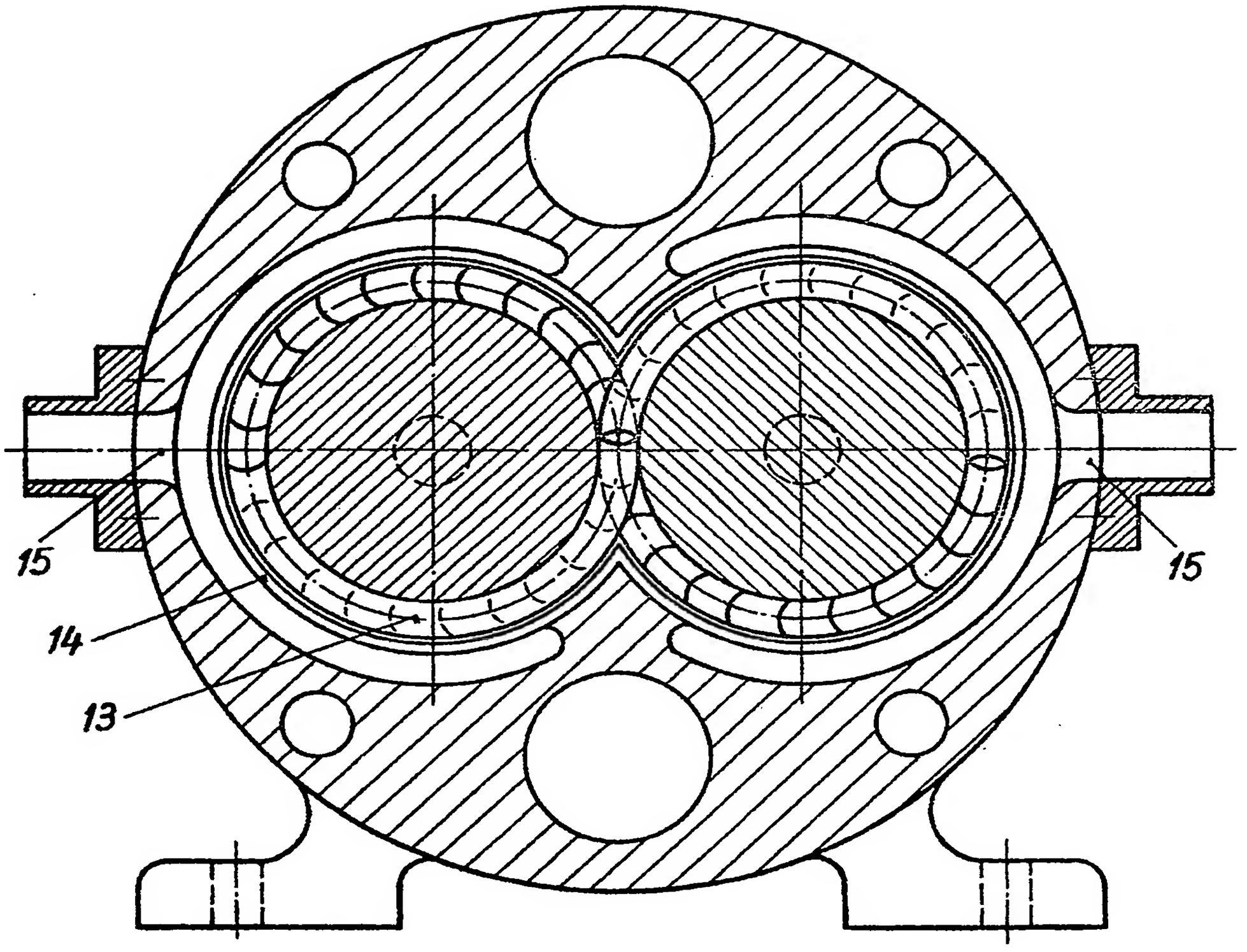


Fig.3

Fig.4



SPECIFICATION

Screw rotary piston machine

The invention concerns a screw rotary piston machine for compressing or expanding a fed-in medium with minimum two mutually meshing screw-type spindles arranged in two parallel axes, with decreasing or increasing thread-type slot section, which spindles are built into a casing with minimum one inlet and minimum one outlet opening.

Commercially known and available are screw compressors used for producing compressed air, with two cylinder-shaped screw compressers used for producing compressed air, with two cylinder-shaped screw bodies rolling off with a constant pitch opposed to their thread, one on the other, and with an invariable thread cross section. Each thread slot turn seals off a volume of air through the points of contact of the two spindles and this volume of air is conveyed from the suction side to the pressure side.

Where major pressure differences between inflow and outflow are involved, the air in the sealed-off volume with its relatively low suction density suddenly meets with the compressed air of the output side, which causes significant deterioration in compressor efficiency as well as annoying noise.

DE-PS 1 553 214 includes a reference to the British patent 890'507 which concerns a screw spindle pump with adjustable output at constant speed. This is achieved by the fact that the screw spindles are provided with a continuously modified thread slot width, with an adjustable case covering a thread installed on top of the two spindles.

This pump can also feature two twin screw spindles, in which version the casing can be provided with one single inlet and two outlets or with two inlets and one single outlet.

With such a continuously modified thread slot section, the volumes sealed off by the threads while the spindles are rolling off one against the other and filled with an elastic medium are modified continuously so that their medium can be compressed or expanded continuously until the desired final density has been achieved.

It is extremely difficult and laborious, however, to manufacture screw spindles rolling off one on the other and with continuously modified thread slot section while ensuring the accuracy required. Even relatively insignificant inaccuracies can impair the necessary tightness in sealing the volumes.

This posed the problem of designing a screw rotary piston machine with screw-type spindles whose thread slot section changes along the thread slot, with the necessary accuracy achieved in a relatively simple manufacturing process. The screw rotary piston machine according to the invention provides a solution for this problem.

The appended drawings show, by way of example, one embodiment of the object of the invention.

Fig. 1 shows a sectional view of a rotary piston machine in the plane determined by the spindle axes.

Fig. 2 shows a sectional view according to line II-II of fig. 1.

Fig. 3. shows the cross section of the spindles according to fig. 2 but on a larger scale

Fig. 4 shows a sectional view according to line IV-IV of fig. 1.

The screw rotary piston machine according to fig. 1 may be used as a compressor for compressing or as a motor for expanding a fed-in gaseous medium. It features two screw-type twin spindles 1a, 1b; 2a, 2b resting on parallel shafts, which twin spindles mesh and roll off one on the other. Both twin spindles 1a, 1b and 2a, 2b are provided each with a shaft journal 3 and each with one drive shaft 4. The shaft journals 3 and the drive shafts 4 are set in roller bearings 5 mounted in two identical and opposite bushings 6 of a machine casing 7. The two drive shafts 4 are mutually connected in a rotary manner by identical spurs 8. The twin spindle halves 1a, 1b; 2a, 2b each display one thread-type slot 9 that decreases in width and in radial depth from the outer spindle end toward the twin spindle center.

Into slot 9 engages a correspondingly designed thread-type cam 10 of the counter-spindle so that through each thread of the two twin spindle halves 1a, 1b; 2a, 2b the lining of casing 7 and cam 10 of the counter-spindle seal off one slot volume filled with the gaseous medium at the counter-spindle roll-off point and in the plane determined by the spindle axes.

The outer diameter of the twin spindles 1ab and 2ab decreases conically toward their longitudinal center whereas the core diameter increases conically toward the longitudinal center. Casing 7 is therefore designed in two parts and provided with longitudinal flanges 11.

If the two twin spindles 1ab, 2ab according to fig. 1 and considered at their upper lining side are rotated against each other, then the machine acts as a compressor with the gaseous medium flowing in through channels 12 of the two bushings 6 and pushed with slot volumes toward the twin spindles 1ab, 2ab where the medium flows into a center groove 13 and through a casing slot 14 through channels 15 out of the machine. As the cross section of thread slot 9 decreases from the longitudinal ends of the twin spindles 1ab, 2ab toward their center, so the individual, sealed-off slot volumes, too, of the threads decrease, while medium pressure and density are rising. In order to prevent any relative backflow of the medium in the variable slot cross section, the first thread at the inflow of the medium and the last thread before the outflow are provided with an invariable thread slot cross section. The axial forces brought to bear upon the spindles because of the pressure difference between medium inflow and medium outflow are compensated at the twin spindles 1ab, 2ab so that the roller bearings 5 are exposed only to a radial load. With the same direction of rotation, the machine can also be used as a vacuum pump to generate low pressure in channels 12. The reduced medium is then condensed to atmospheric pressure level and it will also leave the machine through channels 15.

If a gaseous medium is fed with overpressure into the machine through channels 15, then this medium

can expand in the sealed-off slot volumes in the direction of channels 12 so that the machine acts as a motor. The twin spindles 1ab, 2ab then rotate, considered from their upper lining side (fig. 1) away from each other.

The thread-type slot 9 is limited in its width by plane flats 16 standing perpendicular to the spindle axis while succeeding one another in the helical line and while they are separated one from another by steps 17. This makes the slot 9 appear as a succession of intergrading parallel, laterally offset recesses (fig. 1).

The cross section of the spindles 1a, 1b; 2a, 2b is a circular area with minimum one sector 18 of omega-type shape (fig. 2, 3). With single threading (fig. 1, 2 and 3) the circular area displays but one such sector 18. The latter extends outside over half the circumference of the circular area and is limited radially toward the inside by a concentric semi-circle 19. The ends of the semi-circle 19 are connected by symmetric curves 20 with the ends of the outer disk semi-circle 21 and they form corners 22 with the latter. Where the spindle has a triple-thread design, for instance, three omega-type sectors are distributed evenly over the circumference of the circular area with each sector covering one sixth of the circumference of the circular area.

According to fig. 1 the machine has a circular cross section. Cylinder-shaped holes 23 are used to save material and weight. The two bushings 6 are secured to the casing 7 by tie rods that pass through borings 24.

The machine may also be equipped with twin spindles 1ab, 2ab whose outer diameter increases conically toward the longitudinal center and whose core diameter decreases toward the longitudinal center.

Another advantageous design could be with twin spindles featuring a constant outer diameter as this would allow for building the machine casing 7 in one part and with cylinder-shaped borings.

The spindles 1a, 1b; 2a, 2b could also each display a shaft with ring disks mounted non-shift and closely, which disks have omega-type sectors 18. These ring disks must be set off in such a manner that their sectors 18 form together the thread-type slot 9. The disks referred to are shown in fig. 1 to the right of the twin spindles.

Fig. 3 shows a diagram to the two screw-type spindles 1ab, 2ab, wherein the curves 20 seal off a space 25. In this diagram 9ne corner 22 each of one spindle 1a, 1b rests against one end of the semi-circle 19 of the other spindle 2a, 2b. If the corners 22 move from the upper casing edge 26 to the lower casing edge 27, then they shift on curve 20 first from the outside to the inside toward the ends of the semi-circle 19, while the curved space 25 is forming, and then again from the ends of the semi-circle 19 toward the ontside, while the curved space 25 dissappears again. However, the latter is relatively small and remains open toward slot 9 during its formation and during its reduction. The corners 22 of the spindle cross section area (fig. 3) correspond with the edges of the steps 17 (fig. 1) and provide there for a double seal.

The machine features a simple structural design with only fixed and rotary components of a relatively small diameter, thus allowing for very high speeds. This is meant to provide for a low friction seal through low clearance.

CLAIMS

1. A screw rotary piston machine for compressing or expanding a fed-in medium with minimum two mutually meshing screw-type spindles arranged in two parallel axes, with increasing or decreasing thread-type slot section, which spindles are built into a casing with minimum one inlet and minimum one outlet opening, characterized in that the spindles display minimum one thread-type slot which is formed by step-shaped intergrading recesses arranged successively in the helical line and provided with plane limit flats arranged perpendicular to the spindle centerlines, into which slot in the plane determined by the two spindle centerlines engages a correspondingly designed thread-type cam of the counter-spindle and seals off a slot volume at each thread so that while the spindles roll off, the cam shifts the slot volumes with the medium from the inlet to the outlet, during which the slot volumes are changed and the desired pressure difference between inflow and outflow is achieved, and in that the spindles display in the cross section a circular area with minimum one omega-type sector.

2. A screw rotary piston machine according to claim 1, characterized in that the successive recesses in the helical line display in view of compressing the medium a decreasing width and/or a decreasing radial depth or, in view of expanding the medium, an increasing width and/or and increasing radial depth.

3. A screw rotary piston machine according to claim 2, characterized in that the spindles are designed as twin spindles with an outside diameter that decreases conically toward the longitudinal center and with a core diameter that increases toward the longitudinal center.

4. A screw rotary piston machine according to claim 2, characterized in that the spindles are designed as twin spindles with an outside diameter that increases conically toward the longitudinal center and with a core diameter that decreases toward the longitudinal center.

5. A screw rotary piston machine according to claim 2, characterized in that the spindles are designed as twin spindles with a constant outside diameter.

6. A screw rotary piston machine according to claim 1, characterized in that each threaded spindle displays one shaft onto which are installed non-shift ring disks mounted closely together and provided with minimum one omega-type sector so that the sectors together form the threaded type slot.

7. A screw rotary piston machine substantially as described herein with reference to the accompanying drawings.

8. The features as herein described, or their equivalents, in any novel selection.

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